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$$\phi(a_i)=\pm 1 \text{ and } \psi(a_i)=\mp 1.$$

Hence,

$$\phi(a_i)+\psi(a_i)=0,\ i=1,\ 2,\ \ldots,\ n;$$

and hence the equation

$$\phi(x)+\psi(x)=0,$$

whose degree is less than n, has n distinct roots, which is impossible. Hence, $f_1(x)$ is always irreducible.

Let us next consider $f_2(x)$. If $f_2(x)$ were reducible, we would have

$$f_2(x)=\phi(x)\psi(x),$$

where $\phi(x)$ is irreducible and of a lower degree than n. Then reasoning in the same way as in the first case we find that the equation

$$\phi(x)-\psi(x)=0,$$

which is of a lower degree than n, has n distinct roots. But this is impossible, unless $\phi(x)$ and $\psi(x)$ are identically equal. Hence the only case when $f_2(x)$ is reducible is when it is a perfect square, in which case n of course must be even.

A METHOD OF COMPUTING LOGARITHMS.

By C. E. WHITE, Nashville, Tennessee.

From the expansion $f(x)=f(a)+(x-a)f'(a)+\frac{(x-a)^2}{2\,!}f''(a)+\ldots$ we derive by letting $a=x+h$ and $a=x-h$,

$$f(x)=f(x+h)-hf'(x+h)+\frac{h^2}{2\,!}f''(x+h)-\frac{h^3}{3\,!}f'''(x+h)+\ldots$$

$$f(x)=f(x-h)+hf'(x-h)+\frac{h^2}{2\,!}f''(x-h)+\frac{h^3}{3\,!}f'''(x-h)+\ldots$$

The above expansions may be used to an advantage in computing logarithms if h be determined so that $x+h$ and $x-h$ are each equal to some number whose logarithm is known.

Let us choose h in the first series so that $x+h=1000$ and h in the second series so that $x-h=1000$.

$$f(x+h)=\log 1000,\ f'(x+h)=\tfrac{1}{1000}=.001,\ \frac{f''(x+h)}{2\,!}=.0000005.$$

$$\therefore \log x=\log 1000-(.001h+.0000005h^2+.000000000333h^3+\ldots) \text{ or}$$
$$\log_{10}x=3-M(.001h+.0000005h^2+.000000000333h^3+\ldots)$$

For the second series we get

$$\log_{10}x=3+M(.001h-.0000005h^2+.000000000333h^3+\ldots)$$
$$\log 999=3-.43429\times.001-.43429\times.0000005=2.99956549$$
$$\log 1001=3+.43429\times.001-.43429\times.0000005=3.00043407$$
$$\log 997=3-.43429(.003+.0000045)=2.99869516$$
$$\log 1003=3+.43429(.003-.0000045)=3.00130093$$

The advantage of this method in computing a table of logarith that two logarithms can be computed with little more work than is req to compute one.

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DEPARTMENTS.

SOLUTIONS OF PROBLEMS.

ALGEBRA.

A very good solution of 309 was received from J. M. Arnold.

210. Proposed by B. F. FINKEL, Ph. D., Drury College, Springfield, Mo.

Simplify, $\log[\sqrt[3]{(137)}\ \sqrt[7]{(56)}\div\sqrt[10]{(187)}\ \sqrt[4]{(75)}]$.

Remark by the PROPOSER.

This problem presents no difficulty whatsoever. It was proposed with a view of ascertaining whether different results would be obtained. Only two solutions have been received. We should like to have a large number of solutions.